SNC2D – Chapter 4 – Formation of Ionic Compounds (and naming!)

How Ionic Compounds Form

Bare atoms have the same number of protons ("+") and electrons ("–"), so overall they are neutral. But, to satisfy the **octet rule**, they will try to gain or lose electrons.

> The **octet rule** says that ... molecules or ions tend to be most stable when the outermost electron shells of their constituent atoms contain eight electrons.

When an atom (or group of atoms) loses an electron, it suddenly has one more electron than it has protons. It suddenly has an negative ("–") charge, and we call it an **anion**.

When an atom (or group of atoms) gains an electron, it suddenly has one fewer electron than it has protons. It suddenly has a positive ("+") charge, and we call it a **cation**.

Anions and cations are attracted to each other because – and + are attracted to each other. Thus, anions and cations combine.

We write ions as the elements that they are made out of, with the total charge written as an exponent. If the charge is +1 or –1, we simply write + or – and understand that it's ONE.

Here is a **list of common ions**. You will receive this list for tests in Grade 10, but will not receive it if you take Grade 11 Chemistry.

Li^+	lithium	F^-	fluoride
Na^+	sodium	Cl^-	chloride
K^+	potassium	Br^-	bromide
Rb^+	rubidium	I^-	iodide
Cs^+	cesium	O^{2-}	oxide
Be^{2+}	beryllium	S^{2-}	sulfide
Mg^{2+}	magnesium	N^{3-}	nitride
Ca^{2+}	calcium	H^-	hydride
Sc^{2+}	scandium	P^{3-}	phosphide
Zn^{2+}	zinc	OH^-	hydroxide
Al^{3+}	aluminum	NO_3^-	nitrate
Cu^+	copper (I)	SO_4^{2-}	sulfate
Cu^{2+}	copper (II)	PO_4^{3-}	phosphate
Fe^{2+}	iron (II)	CH_3COO^-	acetate
Fe^{3+}	iron (III)	CO_3^{2-}	carbonate
Sn^{2+}	tin (II)	HCO_3^-	bicarbonate
Sn^{4+}	tin (IV)	CN^-	cyanide
Pb^{2+}	lead (II)	$Cr_2O_7^{2-}$	dichromate
Pb^{4+}	lead (IV)	IO_3^-	iodate
Co^{2+}	cobalt (II)	BrO_3^-	bromate
Co^{3+}	cobalt (III)	ClO_3^-	chlorate
NH_4^+	ammonium	MnO_4^-	permanganate
H^+	hydrogen	SCN^-	thiocyanide

How Compounds Form Between Ions

If a chemist is working with **calcium nitride**, his has a crystal made out of **calcium ions** and **nitride ions**. This is not the most useful information for a chemist, who need to add exact amounts of chemicals together. Chemists use chemical formulas to show how many of each ion there are in a chemical.

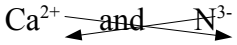
To create the chemical formula of a compound from its name, we figure out what ions it is made from:

calcium nitride

Ca^{2+} and N^{3-}

This makes sense, because positive ions and negative ions attract each other. Two positive ions won't combine to form a compound!

Then, we "criss-cross" the charges on each ion, and get rid of the + and – signs:



Ca_3 and N_2

Then, we write them together to show they are bonded in a single chemical:

Ca_3N_2

This is the chemical formula for calcium nitride.

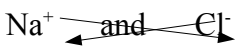
This tells us that we need 2 nitride ions (each with a charge of –3) and 3 calcium ions (each with a charge of +2). To make a unit of calcium nitride.

A couple extra notes:

- Never write "$_1$" after an ion ... just don't write anything. We understand that it's just one if there's no number.

sodium chloride

Na^+ and Cl^-



Na Cl

NaCl

- If either ion is made of more than one element, and gets a subscript, put the ion in brackets to show that it's a package.

ammonium sulfate

NH_4^+ and SO_4^{2-}

NH_4^+ ~~and~~ ~~SO_4^{2-}~~

$(NH_4)_2$ SO_4

$(NH_4)_2SO_4$

- Reduce subscripts to their lowest whole-number ratio

tin (IV) oxide

Sn^{4+} and O^{2-}

Sn^{4+} ~~and~~ ~~O^{2-}~~

Sn_2 and O_4

Sn_2O_4

SnO_2

Try creating the chemical formula for each of the following:

a) sodium oxide
b) rubidium nitride
c) beryllium fluoride
d) scandium sulfide
e) aluminum phosphide
f) potassium hydride
g) copper (II) chloride
h) zinc nitrate
i) iron (II) phosphate
j) lead (IV) cyanide
k) ammonium bromide
l) cobalt (III) chlorate
m) hydrogen fluoride
n) magnesium bicarbonate
o) copper (I) thiocyanide
p) iron (III) dichromate
q) potassium permanganate
r) sodium hydroxide
s) cobalt (II) acetate
t) ammonium nitrate
u) lithium hydride
v) hydrogen cyanide